

MONTANA FISH AND GAME DEPARTMENT  
FISHERIES DIVISION  
HELENA, MONTANA

JOB COMPLETION REPORT  
RESEARCH PROJECT SEGMENT

State of Montana

Project No.: F-9-R-11

Name Southwest Montana Fishery Study

Job No.: III

Title Madison River Study

Period Covered: May 6, 1962 through November 18, 1962

Abstract :

Water temperature observations were made on the main stem of the Madison River during 1962. During the summer, water temperatures up to 77 degrees F. were recorded above Hebgen Lake and up to 79 degrees F. in the lower river near its mouth. Hebgen and Earthquake Lakes had a cooling effect on the river. Meadow Lake caused an increase in the mean water temperature of the river. Fluctuations in summer water temperature were similar to those of 1961 and 1960. However, maximum temperatures at five check points were 3-7 degrees cooler than in 1961, and 2-10 degrees cooler than in 1960.

Recommendations:

Observations for three summers on the Madison River drainage point out the dangers of further warming of the water on this "blue ribbon" trout stream. Since high water temperatures result in a reduction of trout feeding, increased vulnerability to pollutants, diseases, and parasites, the following recommendations are presented:

1. Maintain good flows of water below Hebgen Dam throughout the summer;
2. Restrict the building of shallow water reservoirs on the river such as Meadow Lake;
3. Restrict further development of irrigation projects in the Madison Valley.

Objectives:

This investigation was designed to measure the water temperatures of the Madison River and the reservoirs on the main stem of the stream and to determine the effects of the reservoirs on the temperature of the stream.

Techniques:

This investigation was a continuation of work started in 1960. The data for 1960 and 1961 are summarized in Federal Aid completion reports (Heaton, 1961, 1962). A general description and recent history of the area are outlined in those reports.



In August, 1961, Taylor portable recording thermometers were installed at four stations: above Hebgen Lake, below Hebgen Lake, above Ennis Lake and below Ennis Lake (Fig.1). A maximum-minimum thermometer installed near Three Forks was replaced by a recording thermometer in August, 1962. The instruments were serviced every 7-10 days and were checked periodically with a pocket thermometer. Continuous temperature data were obtained but only weekly maximum and minimum temperatures are used in this report.

### Findings:

The Madison River is formed by two major tributaries, each receiving large amounts of hot water from geyser basins in their drainages. Thermal water from the geysers cause year around temperatures in the Madison River to be much higher than other streams at this altitude (6,667 feet near West Yellowstone).

Water temperatures in the main stem of the Madison River during 1962 followed a pattern of fluctuation similar to that in 1961. However, peak water temperatures from late June through August were 3 degrees cooler upstream from Hebgen Lake to 7 degrees cooler upstream from Meadow Lake than in 1961.

Water temperatures were highest above Hebgen Lake, with maximum readings of 75-77 degrees F. through the month of July and the first week in August (Fig. 2). During the period of June 1 to September 1, the temperature range was 49-77 degrees F. compared to 51 to 80 degrees for the same period in 1961. A temperature of 81 degrees F. was recorded in late July of 1960. Daily fluctuations were as high as 17 degrees during the summer. Winter water temperatures above Hebgen ranged from 32 to 58 degrees F. from January 1 to April 18. Maximum water temperatures were at least 40 degrees F. during this period, except for the last three weeks of January when maximum readings were between 33 and 35 degrees F.

The maximum temperature recorded below Hebgen in 1962 was 64 degrees F. (Fig. 2) in early July, while in 1961, 64 degrees F. was common the last half of June and early July. The warmest temperature recorded below Hebgen in 1960 was 68 degrees F. Hebgen Lake serves to cool the river below during the critical summer months since water is drawn from the bottom of the dam. Winter water temperatures below Hebgen Lake ranged from 37-38 degrees F. from January 1 to April 18.

Spot checks on the major tributaries flowing into Hebgen Lake were too scanty to determine when maximum temperatures occurred. However, 70 degrees F. was the warmest temperature recorded on these in 1961.

From Hebgen Lake, the Madison River flows into Earthquake Lake. In 1960 and 1961, water temperatures below Earthquake Lake were found to follow a pattern similar to that below Hebgen Lake. Below Earthquake Lake, the river leaves the mountains and flows through a wide valley to Meadow Lake. Water temperatures increase steadily between Earthquake and Meadow Lakes during hot days. Maximum temperatures recorded above Meadow Lake from mid-June through August were 60-70 degrees F. (Fig. 3) compared to 70-77 degrees F. for the same period in 1961, and 70-78 degrees F. through most of July in 1960.

Below the town of Ennis, the Madison River flows into Meadow Lake, a wide shallow (33 feet maximum depth) impoundment. Frequent strong winds prevent stratification of the lake, and as a result, the daily mean temperatures of the river below were increased during the summer. Maximum

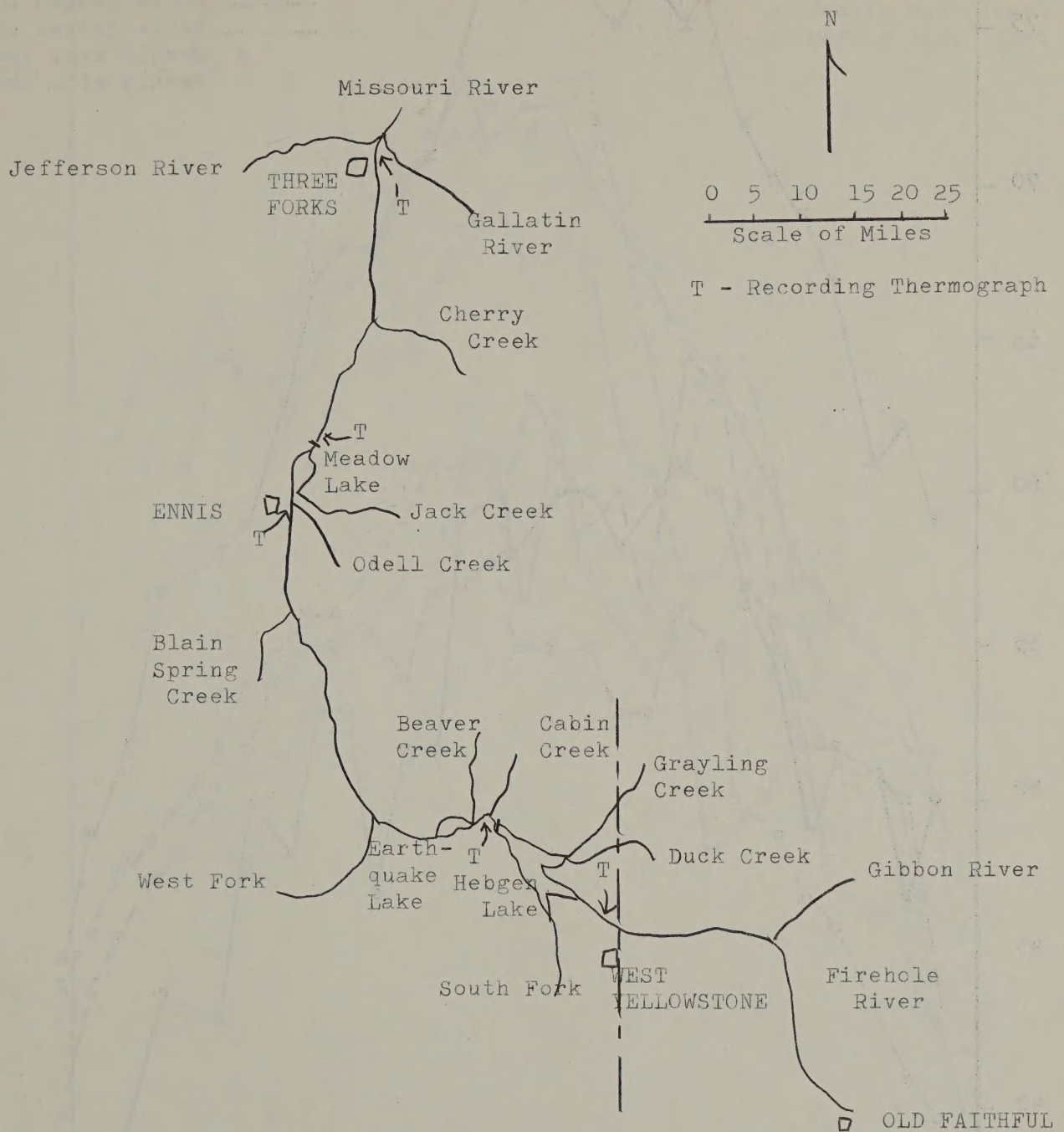


Figure 1. The Madison River Drainage showing the major tributaries, impoundments, and the location of temperature recording stations.



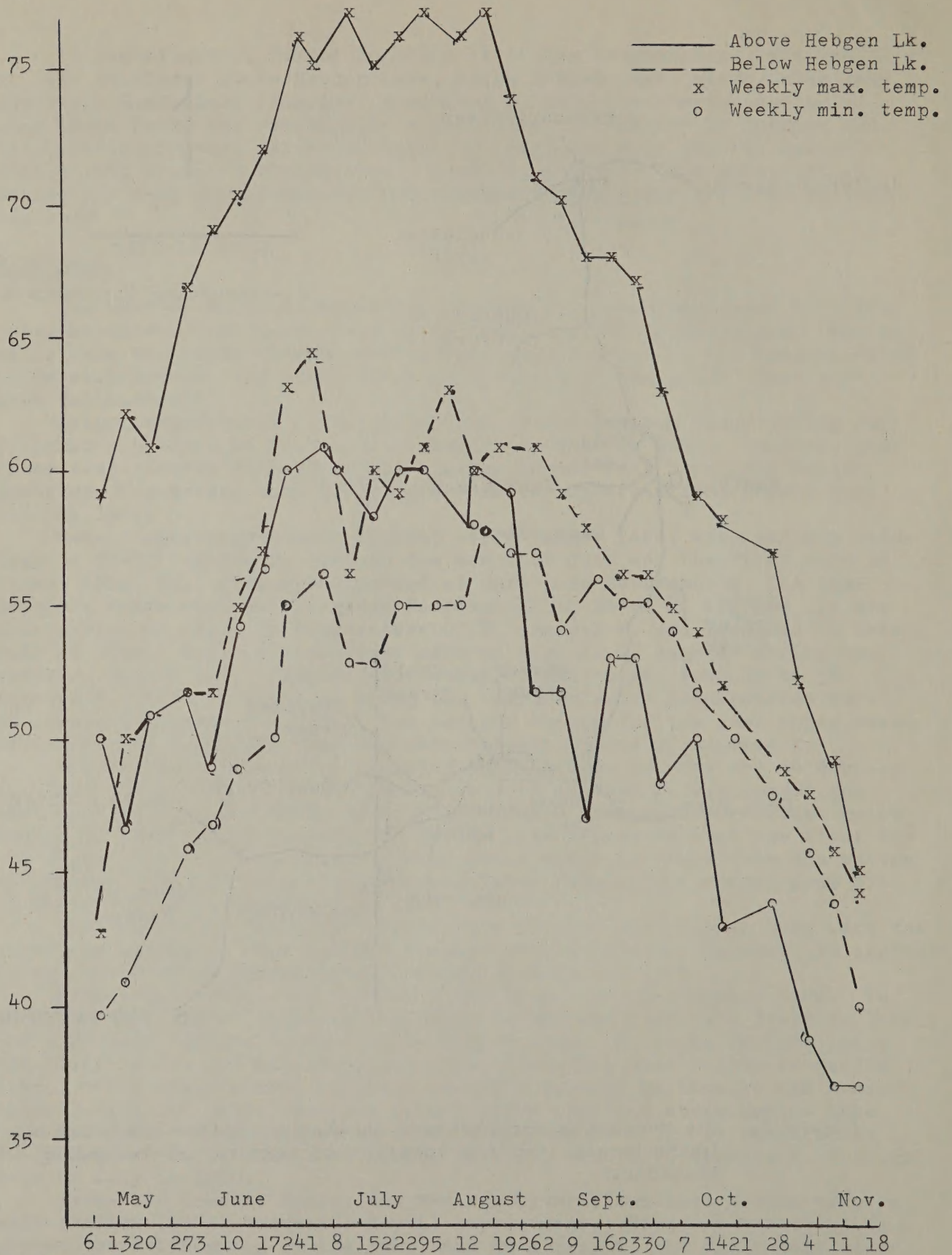


Figure 2. Weekly maximum and minimum water temperatures for stations above and below Hebgen Lake from May 6 through November 18, 1962.

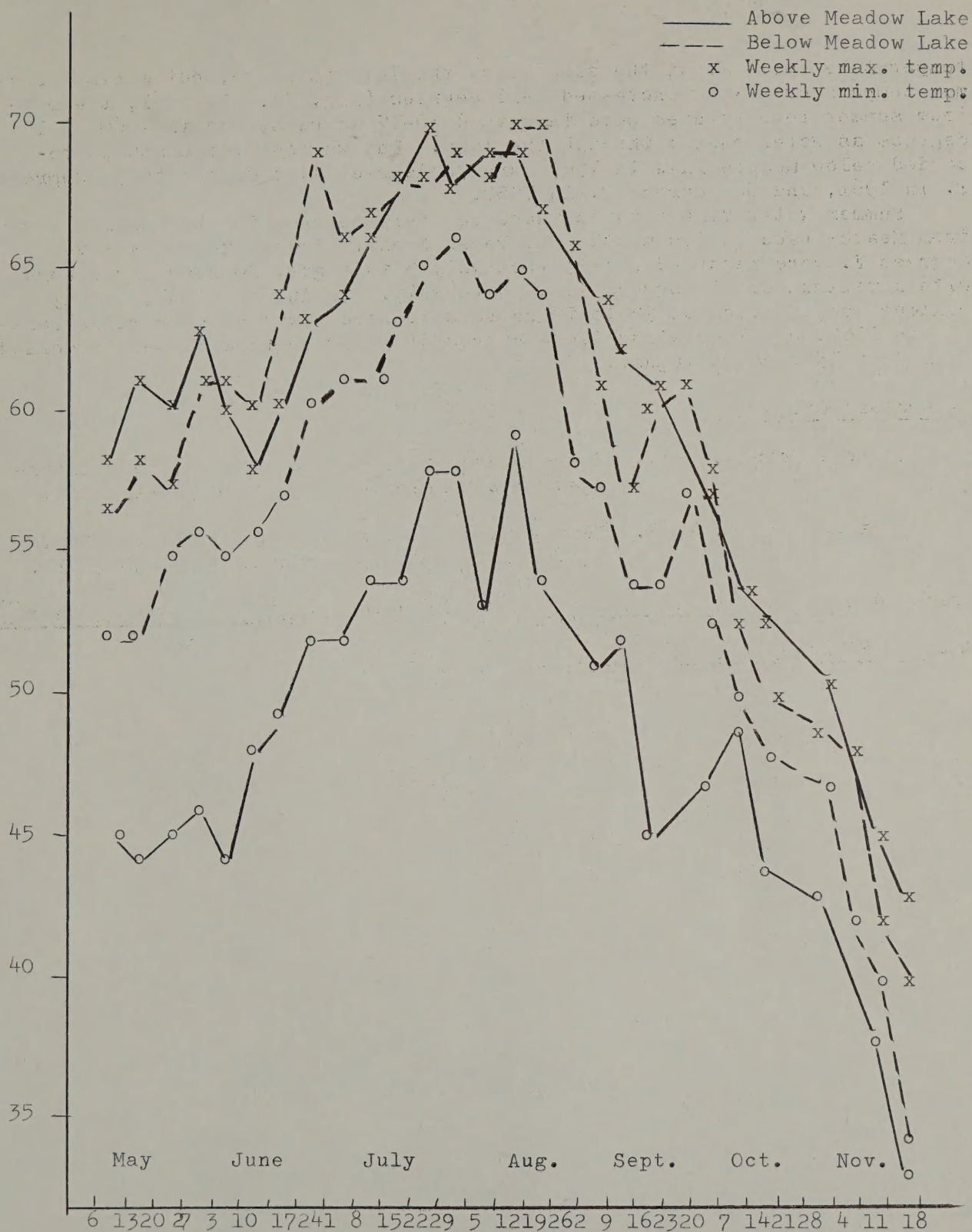


Figure 3. Weekly maximum and minimum water temperatures for stations above and below Meadow Lake during May 6 through November 18, 1962.

temperatures were about the same below the lake as above, but minimum summer temperatures were increased 6-11 degrees (Fig. 3). In 1961, the minimum summer temperatures were increased 10-17 degrees, and in 1960, 2-17 degrees as water passed through the lake. The warmest temperatures recorded below Meadow Lake in 1962 were 70 degrees F. compared to 73 degrees F. in 1961, and 80 degrees F. in 1960.

Summer water temperatures increased 5-10 degrees in the Madison River from Meadow Lake to its mouth near Three Forks. Temperatures over 74 degrees F. were recorded weekly from July 5 to August 20 near Three Forks with a maximum of 79 degrees F. in late July. In August, 1961, weekly maximum temperatures of 77 to 79 degrees F. were recorded near Three Forks, and in 1960, weekly maximum temperatures of 75-80 degrees F. were recorded from July 15 through August.

Literature Cited:

Heaton, John R. 1961. Temperature study of the Madison River Drainage. Job Completion Report, F-9-R-9 (IIB).

Heaton, John R. 1962. Temperature study of the Madison River Drainage. Job Completion Report, F-9-R-10 (III).

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